Prospective Study

The Efficacy of Erector Spinae Plane Block Compared With Intrathecal Morphine in Postoperative Analgesia in Patients Undergoing Lumbar Spine Surgery: A Double-blind Prospective Comparative Study

Atef Mohamed Mahmoud, MD, Safaa Gaber Ragab, MD, Mohamad Ahmed Shawky, MD
Doha Hamad Masry, MSc, Joseph Makram Botros, MD

From: Pain and Intensive Care Medicine, Fayoum University, Fayoum, Egypt

Address Correspondence:
Atef Mohamed Mahmoud, MD
Pain and Intensive Care Medicine, Faculty of Medicine, Fayoum University
Fayoum 63512, Egypt
E-mail: amko4@fayoum.edu.eg

Disclaimer: There was no external funding in the preparation of this manuscript.

Conflict of interest: Each author certifies that he or she, or a member of his or her immediate family, has no commercial association (i.e., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted manuscript.

Manuscript received: 08-01-2022
Revised manuscript received: 10-14-2022
Accepted for publication: 11-10-2022

Free full manuscript: www.painphysicianjournal.com

Background: Severe postoperative pain is experienced by most patients who undergo spine surgery. Erector spinae plane block (ESPB) is a successful method for postoperative analgesia and has only minor complications. Intrathecal morphine (ITM) demonstrates high efficacy for analgesia up to 24 hours postsurgery. ESPBs and ITM for postoperative analgesia in lumbar spine surgeries have never been compared in prior studies.

Objectives: This study aimed to compare the efficacy of ESPB and ITM in postoperative analgesia after lumbar spine surgeries.

Study Design: A double-blind prospective comparative study.

Setting: This study was performed at Al Fayoum University Hospital after being confirmed by the local institutional ethical committee (#80) with approval number M520 and retrospectively registered at clinicaltrials.gov number (NCT05123092).

Methods: A prospective randomized double-blinded interventional trial was conducted with 82 patients, 41 in each group. In the ESPB group, a 0.25% bupivacaine injection was used to conduct a bilateral ultrasound-guided ESPB. In the ITM group, an injection of 0.3 mg morphine intrathecally was done. The Visual Analog Scale (VAS) was recorded as the primary outcome. The time to the first analgesic request, intra- and postoperative opioid consumption, hemodynamics, sedation score, and complications were also recorded as secondary outcomes.

Results: Postoperative VAS scores were significantly lower in the intrathecal group throughout the postoperative period at all recorded study time points until 48 hours ($P < 0.001$). Time to the first rescue analgesia and doses of postoperative analgesic required were significant, with a P value of 0.000. Significant differences were found in postoperative oxygen saturation up to 24 hours ($P < 0.001$) and the sedation score up to 6 hours ($P < 0.01$). A higher incidence of complications was recorded in the ITM group ($P = 0.000$).

Limitations: We did not measure patient preoperative VAS scores to ensure that the 2 groups were matched in pain severity. Also, we did not compare patient satisfaction. Another limitation was the inability to determine the degree of pain relief of ESPB since there was no control group in our study.

Conclusion: We concluded that ITM 0.3 mg provides more potent analgesia up to 48 hours postoperatively than an ESPB, based upon VAS score, analgesic durations, and postoperative analgesic requirements.

Key words: Intrathecal morphine, erector spinae, spine, Visual Analog Scale

Pain Physician 2023: 26:149-159

Moderate to severe postoperative pain is experienced by most people scheduled for spine surgeries. The pain mechanism involves nociceptive, neuropathic, and inflammatory sources (1). Immobilization, chronic pain, thromboembolism, increased opioid intake, and a prolonged hospital stay are all repercussions of poor pain management (1,2). Multimodal analgesia regimens involving various drugs and methods are considered crucial for postoperative pain control. After ultrasound introduction in regional anesthetic practice, regional anesthetic procedures such as paravertebral blocks and epidural analgesia have become significant aspects of the multimodal analgesic regimen (3).

One of the most recent advancements in postoperative pain management is the erector spinae plane block (ESPB) that was initially demonstrated in 2016 (4). This block involves injecting a local anesthetic into the plane between the erector spinae muscle and the transverse process of the vertebra. The local anesthetic spreads on a plane caudally and cranially, allowing the sympathetic nerve fibers, as well as the spinal nerves' dorsal and ventral rami, to be blocked in a multilevel orientation down the vertebral column. ESPB is utilized for analgesia following mastectomy, thoracic, abdominal, and spine surgery, and is more practical than epidural analgesia because of its simplicity and reduced risk (4,5).

In several surgical procedures, intrathecal morphine (ITM) has been utilized successfully for postoperative analgesia. Morphine is a hydrophilic opioid which means that it has a lower clearance from the cerebrospinal fluid than other opioids. ITM's analgesic effects can persist up to 24 hours. The use of ITM in spine procedures has been limited due to vulnerability to postoperative respiratory depression, sedation, nausea, vomiting, pruritus, and urine retention. Less common complications like bradycardia, diaphoresis, delayed gastric emptying, constipation, headache, persistent hiccup, and priapism have also been reported (6-8). In patients undergoing lumbar spine procedures, ESPB's efficacy and safety compared with ITM have not been compared in previous studies. Therefore, the current study aimed to assess and compare the efficacy of ESPB with ITM in postoperative analgesia.

Methods

This study was performed at Al Fayoum University Hospital after being confirmed by the local institutional ethical committee (#80) with approval number M520 and retrospectively registered at clinicaltrials.gov number NCT05123092. Before enrollment and randomization, eligible patients provided their written, informed consent after the study's aim was explained to them. The current investigation was a randomized, double-blinded, prospective comparative study. Patients with American Society of Anesthesiologists (ASA) physical status I or II were scvheduled for elective lumbar discectomy or fixation at one or 2 levels. The patients were between the ages of 18 and 70.

The exclusion criteria included patient refusal; serious cardiovascular, hepatic, or renal problems; an allergy to the drugs in the study; pregnancy; and any contraindication to a local anesthetic, such as bleeding disorders or local infection. Chronic opioid usage, a history of chronic pain, cognitive impairments, and those with a revision of the lumbar spine surgeries were also excluded from the study.

Computer-generated random numbers were deposited in sealed envelopes and inspected by research investigators immediately after providing general anesthesia. The patients then were allocated whether to the ITM group (n = 41) or the ESPB group (n = 41) according to the randomization.

All patients were given 20 mg of famotidine oral tablets as premedication the night before surgery, as well as on the morning of the surgery. When the patients came into the operating room, standard monitors (noninvasive blood pressure monitoring, pulse oximeter, and 5-lead electrocardiogram) were applied and maintained throughout the surgery. An intravenous line was applied. For general anesthesia, intravenous propofol (2 mg/kg), fentanyl (1 μg/kg), and atracurium (0.5 mg/kg) were utilized. To keep the airway open, a cuffed endotracheal tube (7.5-8) size was used. The patients were positioned supine at the induction of anesthesia. Inhalational anesthesia with 1.5% isoflurane and intravenous atracurium (0.1 mg/kg) was used to maintain anesthesia according to each patient's needs.

Then, the patients were turned and placed prone. An anesthesiologist with experience in ultrasound-guided regional anesthesia, who did not share in data collection or analysis, executed the block behind a screen. In the ESPB group, a high-frequency linear ultrasound probe (8 MHz - 12 MHz) connected to a Philips ClearVue 350 (Philips N.V.) was implanted vertically and almost 3 cm lateral to the vertebra in the middle of the incision line. The transverse process and underlying erector spinae muscles were determined by parasagit-

tal scanning. A 22G, 50 mm block needle (SONOTAP, Pajunk) was inserted under sterile conditions in the craniocaudally using an in-plane approach at a 30° - 40° angle. The proper needle site was confirmed with 3 mL isotonic saline after hydrodissection in the interfascial plane between the rhomboideus major muscle and the erector spinae muscles; 20 mL of 0.25 % bupivacaine was then injected. The local anesthetic dispersion was detected deep into the erector spinae muscles in a fascial longitudinal pattern. On the opposite side, an identical operation was carried out.

In the ITM group, a lumbar puncture with a 25G Quincke needle was conducted laterally under complete aseptic conditions. The puncture was at the intervertebral space that existed in the middle of the height of the incision. A total of 0.3 mg of diluted morphine (preservative-free form) suspended in 0.4 mL of normal saline with a total volume of 0.7 mL was administered. After a patient's spontaneous respiration returned, the anesthesia was stopped, and the patient extubated.

Before being transferred to the ward, all patients were followed up for an hour in the postanesthesia care unit and placed on nasal cannula 2 L/min oxygen and monitors. In the postoperative phase, the following multimodal analgesic regimen was used: 1,000 mg intravenous acetaminophen 3 times/d; 30 mg intravenous ketorolac once daily; and 0.5 mg/kg intravenous pethidine as a rescue analgesic on demand.

The Visual Analog Scale (VAS 0: no pain, 10: worst pain ever) was used to assess postoperative pain at 0 hours postoperative in the postanesthesia care unit, then at 2, 6, 12, 24, and 48 hours in the ward. When the VAS score was more than 3, 0.5 mg/kg intravenous pethidine was given as rescue analgesia. Between 0-12, 12-24, and 24-48 hours, the following data were recorded: the amount of pethidine consumed; postoperative opioid consumption; ASA physical status classification; VAS scores; time to first rescue analgesia (measured in hours, and defined as the time from block completion to the first request for analgesia); mean operative times (in minutes); intraoperative fentanyl consumption (μg); Ramsay Sedation Scale score (one for agitated and anxious, restless, or both, 2 for cooperative, tranquil, and oriented, 3 for only response to commands, 4 for rapid response to a glabellar tap or a harsh aural stimulation, 5 for a sluggish response to a light glabellar tap or loud auditory stimulus, 6 for no response to a light glabellar tap or loud auditory stimulus); as well as postoperative and intraoperative hemodynamics (SpO_2, heart rate, and blood pressure), and complications (9).

The current study's primary outcome was the mean VAS score in the 2 groups (score 0 = no pain, 10 = worst pain ever). The secondary outcomes were ASA physical classification, mean operative times in minutes, demographic data (age, height, weight, body mass index), time to the first rescue analgesia in hours, sedation score, postoperative opioid consumption, postoperative and intraoperative hemodynamics (blood oxygen saturation, blood pressure, and heart rate), and intraoperative fentanyl consumption in μg. Nerve injury, local anesthesia toxicity, hemorrhage, infection, and thrombosis are examples of complications connected to the block and surgery, as well as issues related to intrathecal morphine, general anesthesia, and intravenous opioid administration (constipation, nausea, vomiting, bradycardia, respiratory depression, hypotension, pruritus, and dizziness). Bradycardia was defined as a heart rate below 60 beats/min and managed by 0.5 mg atropine and subsequent doses if needed; constipation was managed by laxative if it occurred. The patients, surgeons, and data collectors, whether intraoperatively or postoperatively, were blinded for the intervention procedure.

Sample Size Calculation and Statistical Analysis

The sample size was calculated using G*power version 3.1.9.4 software (Heinrich Heine University) (10). According to prior research, with a power level of 0.80, for the VAS score at 24 hours to have a mean effect size of 0.66 and an α level of 0.05 (2-tailed) required a minimum sample size of 37 patients in each group (11,12). The sample size was raised to 82 patients after it was estimated that 10% would drop out for various reasons (41 in each group). IBM SPSS Statistics 21.0 21.0 was utilized (IBM Corporation). The data are provided as a mean (SD), the number of patients (percent), or median (interquartile range [IQR]). To observe if the distribution was normal, the Shapiro-Wilk test was utilized. Independent t tests or Mann-Whitney U tests were performed to make group comparisons. The χ^2 test or Fisher's exact test was utilized to determine categorical variables. A *P* value of less than 0.05 was considered statistically significant. A linear mixed model was used to account for multiple testing. A fixed effect model was used for the intervention group, and a random effect model was used to adjust for patients' effects. Repeated measures over time were adjusted using heterogeneous AR(1) as a covariance structure because it had the lowest corrected Akaike's information criterion.

Results

Ninety-four patients were deemed eligible for the study. Two patients refused to participate, and 5 were ruled out because they did not meet the inclusion criteria; one operation was canceled due to a possible fever. Eighty-nine patients underwent interventions. Forty-five were assigned to ITM, but only 41 (91%) received it. Four patients did not receive the block (2 required blood transfusion, one was lost to follow-up, and one patient failed to receive the block). Forty-four patients were assigned to have ESPB, but only 41 (91%) received it. Three patients did not receive the block (2 were lost to follow-up, and one monitor malfunctioned) (Fig. 1). This study was conducted from January 10, 2021, through February 20, 2022.

There were no significant differences between the 2 groups regarding the demographic and surgical data ($P > 0.05$) (Table 1). The postoperative VAS scores were significantly lower in the ITM group than the ESPB group throughout all the recorded postoperative study time points until 48 hours postoperative (Table 2). During the entire postoperative period, VAS scores were higher in the ESPB group than the ITM group; the estimate (95% CI) equals 1.989 (1.664 - 2.314), t = 12.198, $P < 0.001$.

The time to the first analgesic request was significantly longer in the ITM group (median [IQR]) was 22 (14) hours compared to the ESPB group which was 10 (1) hours. Also, total 48-hour postoperative pethidine consumption was significantly lower in the ITM group was 87.5 (44) mg compared to the ESPB group 112 (13) mg (Fig. 2). In contrast, a nonsignificant difference was found between the 2 groups in intraoperative fentanyl consumption. A nonsignificant difference was found between the 2 groups considering intraoperative heart rate until 2 hours

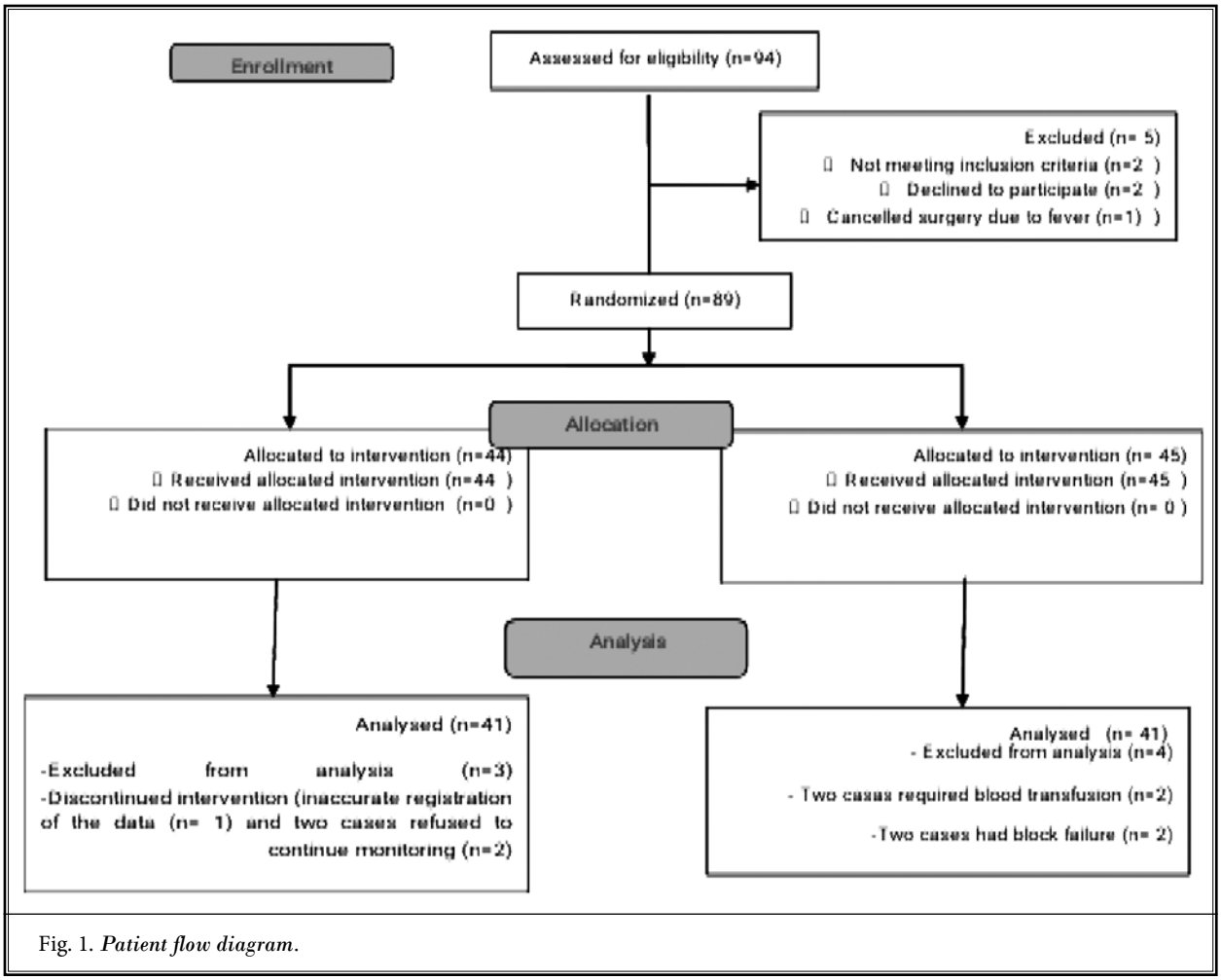

Fig. 1. *Patient flow diagram.*

Table 1. *Comparison of the patients' demographic data, surgical level, and duration of surgery.*

	ESPB (n = 41)		ITM group (n = 41)		*P* Value
	Number	Percentage	Number	Percentage	
#Gender					
Men	22	54%	21	51 %	0.825
Women	19	46%	20	49 %	
#ASA Physical Status					
I	26	63%	30	73 %	0.342
II	15	37%	11	27 %	
#Number of surgical levels					
One	24	59%	24	59%	1
Two	17	41%	17	41%	
	Mean	SD	Mean	SD	P value
*Age (years)	40.8	12	45.1	8.4	0.066
*BMI (kg/m^2)	24.4	2.7	25.2	2.9	0.168
*Duration of surgery (minutes)	129.3	9.1	129.3	26	0.987

χ^2 test, * Independent t test

Table 2. *Comparison of Visual Analog Scale scores between groups. Data are presented as median (IQR) [Range].*

#Visual analog scale	ESPB group (n = 41)			ITM group (n = 41)			*P* Value
	Median	IQR	Range	Median	IQR	Range	
Immediately postoperative (0 hours)	2	(0)	[7]	0	(0)	[7]	0.000*
2 hours postoperative	2	(1)	[1]	0	(1)	[3]	0.000*
6 hours postoperative	3	(0)	[4]	1	(2)	[5]	0.000*
12 hours postoperative	4	(1)	[4]	2	(3)	[5]	0.000*
24 hours postoperative	4	(1)	[2]	3	(3)	[7]	0.000*
48 hours postoperative	5	(1)	[2]	4	(1)	[3]	0.000*

IQR: Inter quartile range. #Mann-Whitney U test, * *P* value < 0.05

postoperative (*P* > 0.05), except at 30 minutes (*P* = 0.022). Nevertheless, the heart rate was significantly lower in the ITM group compared to the ESPB group in all study postoperative time points except 24 hours (*P* = 0.045) (Fig. 3).

A significant difference was found regarding the mean arterial blood pressure readings immediately postoperative, 4 hours postoperatively, and 24 hours postoperatively (*P* < 0.05). At the same time, there were nonsignificant differences at the remaining postoperative times (*P* > 0.05). Also, a nonsignificant difference was found considering the intraoperative mean arterial blood pressure measurement except at 120 minutes (Figs. 4,5).

A significant difference (*P* < 0.05) was recorded regarding postoperative oxygen saturation at all postoperative study time points. We observed a nonsignificant difference in the intraoperative oxygen saturation (*P* > 0.05) (Table 3).

A significant difference was found between the 2 groups regarding postoperative Ramsay Sedation Scale score in the first 6 hours postoperatively (*P* < 0.05), while a nonsignificant difference was observed at the remaining study time points (*P* > 0.05) (Fig. 6).

A significant difference was found regarding the incidence of complications with no complications found in the ESPB group; there were 33 patients (80%) in the ITM group that had at least one complication (Table 4).

Discussion

In our study, we compared ESPB with ITM in elective lumbar disc surgery. A significant difference was found regarding the postoperative VAS score (the primary outcome) throughout the first 48 hours postoperatively at all recorded study time points (*P* < 0.001) until 48 hours postoperatively. This reflects the strength and extends the analgesic effect of this dose

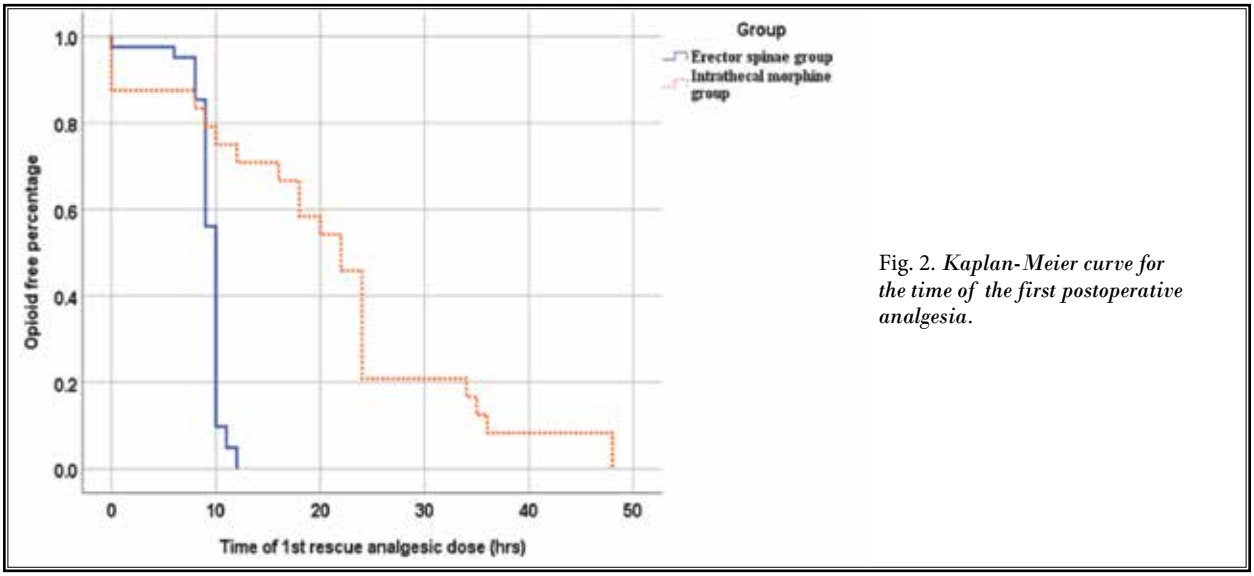

Fig. 2. *Kaplan-Meier curve for the time of the first postoperative analgesia.*

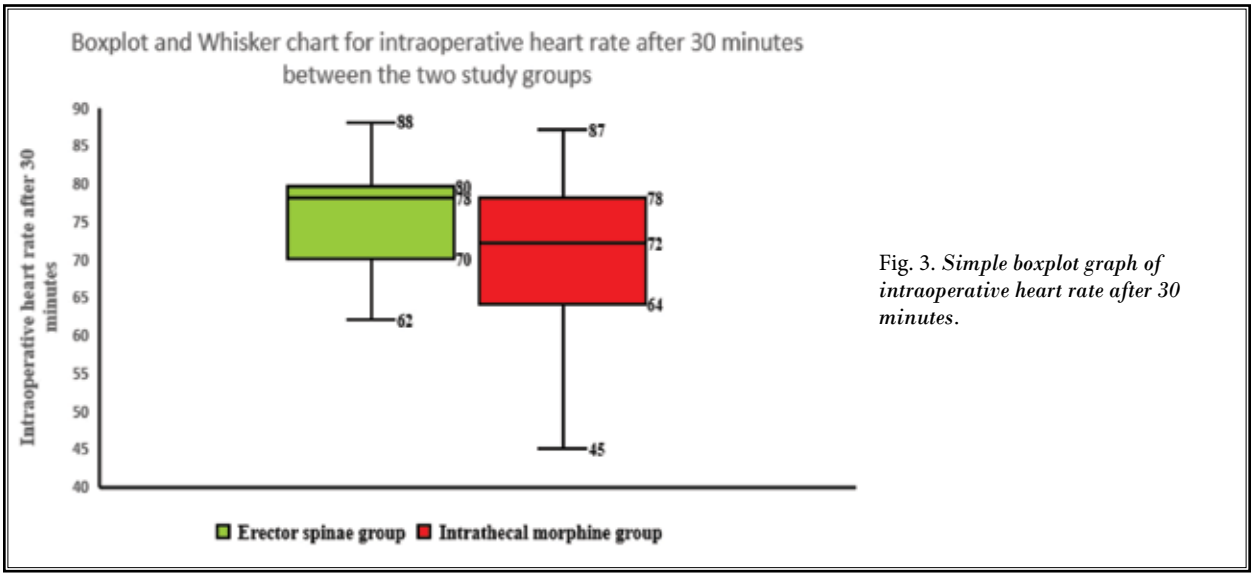

Fig. 3. *Simple boxplot graph of intraoperative heart rate after 30 minutes.*

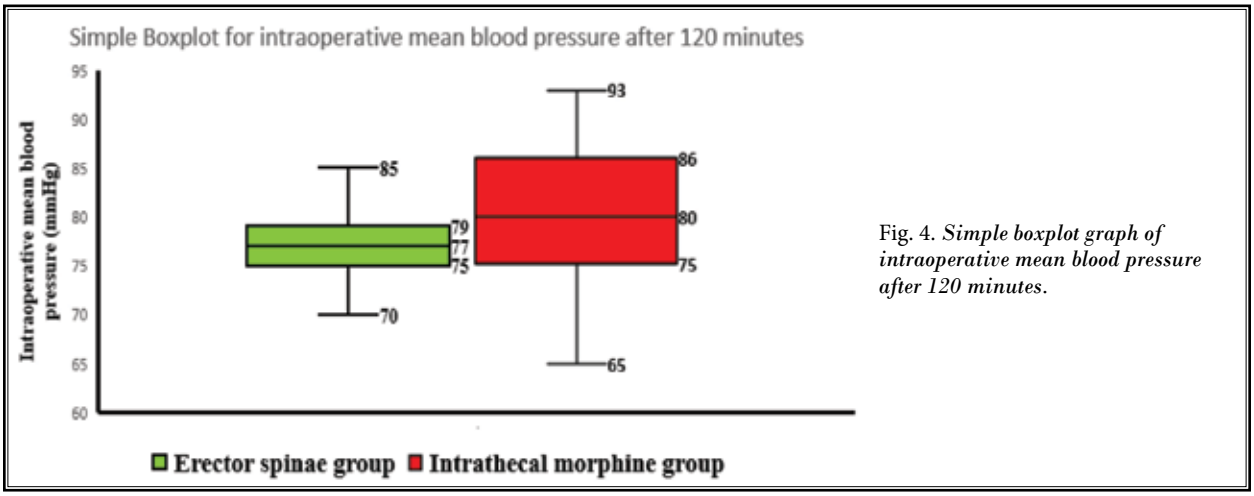

Fig. 4. *Simple boxplot graph of intraoperative mean blood pressure after 120 minutes.*

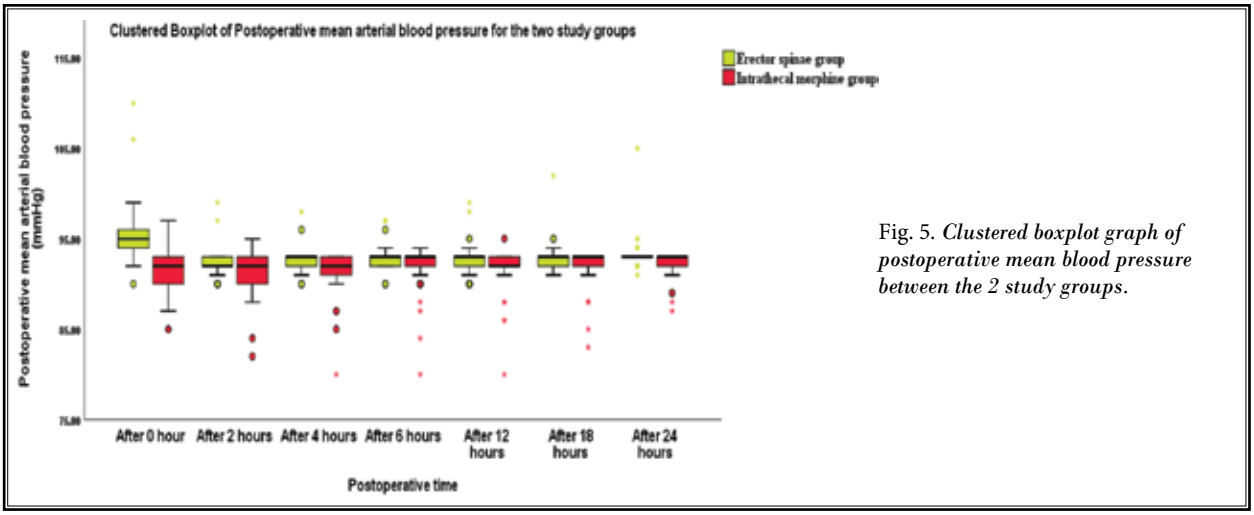

Fig. 5. *Clustered boxplot graph of postoperative mean blood pressure between the 2 study groups.*

Table 3. *Comparison of postoperative oxygen saturation between the 2 groups. Data are presented as median (IQR) [Range].*

#Postoperative oxygen saturation (%)	ESPB group (n = 41)			ITM group (n = 41)			*P* Value
	Median	IQR	Range	Median	IQR	Range	
Immediately postoperative (0 hours)	96	(1)	[3]	96	(1)	[3]	0.000*
2 hours postoperative	98	(1)	[3]	97	(2)	[4]	0.000*
4 hours postoperative	98	(1)	[3]	97	2	[4]	0.000*
6 hours postoperative	99	(1)	[2]	97	1	[3]	0.000*
12 hours postoperative	99	(1)	[2]	97	1	[3]	0.000*
18 hours postoperative	99	(1)	[2]	97	1	[3]	0.000*
24 hours postoperative	99	(1)	[2]	97	1	[3]	0.000*

IQR: Inter quartarile range. # Mann-Whitney U test,* *P* value < 0.05

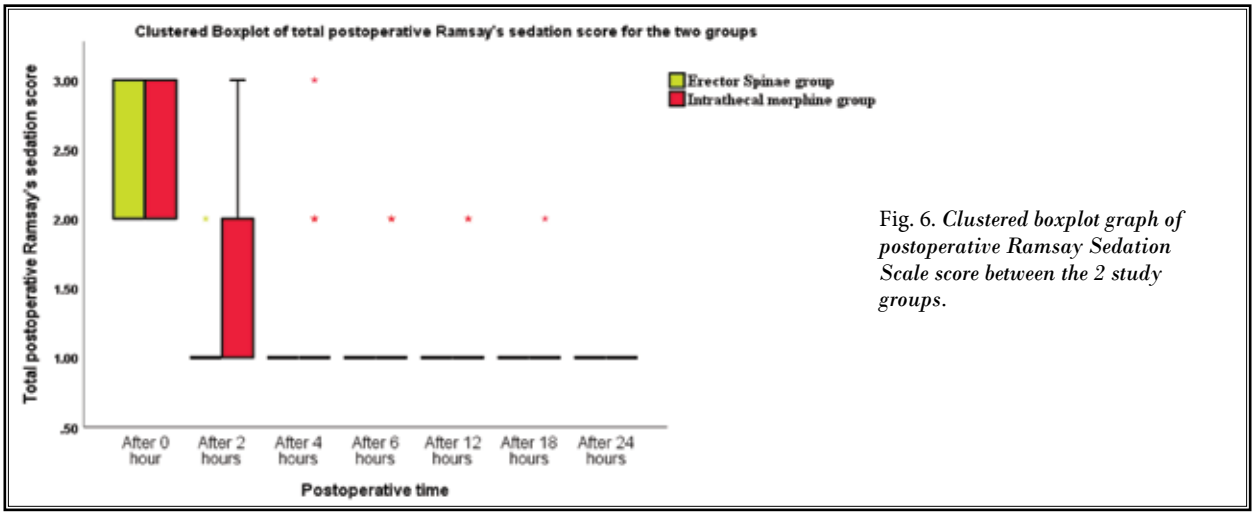

Fig. 6. *Clustered boxplot graph of postoperative Ramsay Sedation Scale score between the 2 study groups.*

of intrathecal morphine on inhibiting pain perception and transmission. Also, we found significant differences in the intraoperative and postoperative heart rate and mean arterial blood pressure. Moreover, significant differences were reported in postoperative oxygen saturation, time to the first analgesic request,

Table 4. *Comparison of the occurrence of complications between the 2 groups*[#].

	ESPB Group (n = 41)		ITM Group (n = 41)		*P* Value
	Number	Percentage	Number	Percentage	
No	41	100 %	8	20 %	0.000*
Yes	0	0 %	33	80 %	
#One complication			15	36 %	
#Urine retention			12	29 %	
#Constipation			2	5 %	
#Nausea & vomiting			1	2 %	
#More than one complication			18	44 %	

#χ^2 test, * *P* value < 0.05

doses of postoperative analgesic request, and intra and postoperative sedation scores between the groups.

According to Kroin et al (13), the hydrophilic feature of morphine reduces capillary loss in the spinal cord, resulting in a larger concentration of accessible morphine in the cerebrospinal fluid and a broader band of analgesia, albeit not being considerably higher. Sawi and Choy (14) reported significantly lower pain scores in their morphine group up to 20 hours postoperatively.

Similarly, Kong et al (15) reported that a small dose of ITM (0.2 mg) produced excellent postoperative analgesia for the first 48 hours after laparoscopic colorectal surgery. The efficacy of 0.4 mg of ITM in delivering postoperative analgesia in patients undergoing posterior interbody fusion operations was shown by Ziegeler et al (16). Raw et al (17) recommended 3-5 µg/kg in conjunction with intravenous patient-controlled analgesia to provide appropriate analgesia for the same procedure while lowering the risk of respiratory depression (17). A dose of 0.02 mg/kg of ITM reduced the need for further analgesics in the first 12 hours following surgery in studies conducted by Urban et al (18) and Hindle et al (19).

Intrathecal opioids act pre-and postsynaptically by inhibiting adenylate cyclase, decreasing presynaptic calcium entry, lowering intracellular calcium levels, reducing excitatory neurotransmitter release (glutamate and substance P), and hyperpolarizing the membranes of dorsal horn neurons by increasing postsynaptic efflux of K+. The normal enteral and parenteral doses used in clinical practice could not achieve the drug concentration required for such effects. Direct administration to the intrathecal region allows for easy attainment of the required high concentrations (8,20,21).

Selective spinal analgesia refers to opioids' impact on the dorsal horn, producing targeted analgesic impacts with minimal motor, sensory, and autonomic consequences (8,21,22). Glycine and gamma-aminobutyric acid (GABA), for example, are inhibitory transmitters that play a role in opioid-mediated analgesia by activating descending inhibitory pathways. When intrathecal morphine is utilized, these effects can last 24 hours postsurgery (20).

Chin and El Boghdady (23) described the probable mechanisms of ESPB. These include neural blockade and central inhibition from the direct spread of local anesthetic to the paravertebral or epidural space; analgesia facilitated by the upraised plasma local anesthetic concentrations owing to systemic absorption; immunemodulatory effects of local anesthetics; and an effect that is arbitrated through the mechanosensory possessions of the thoracolumbar fascia (23). Based on clinical evidence, the most likely main mechanism is a direct effect of local anesthetic via physical spread and diffusion to neural structures in the fascial planes deep into the erector spinae muscles and adjacent compartments. There is consistent involvement of the dorsal rami; the epidural spread is a less commonly observed phenomenon. A systemic effect of local anesthetic is also probable, but doubtful to play a chief role in the clinical analgesic efficacy (23).

Regarding the changes in the mean arterial blood pressure, we found it was significantly lower in the ITM group than the ESPB group intraoperatively only at 120 minutes and postoperatively at multiple study time points: immediately postoperative, at 4 hours postoperative, and at 24 hours postoperative. With similar results, we reported a significant difference between the groups in heart rate intraoperatively only at 30 minutes postoperative and only at 24 hours postoperative. Consistent with our results, Fares et al (24) found a nonsignificant effect with varying ITM doses (0.2 mg, 0.5 mg, 1 mg) on patients having major abdominal cancer surgery. However, individuals who received a high dose of ITM of one mg at 12 and 18 hours postoperatively had a trend toward decreased mean systolic blood pressure. Patients who received ITM (1 mg) had lower mean heart rate values at 6 and 12 hours postoperatively ($P < 0.05$) compared to the other 2 groups, with a nonsignificant difference between the groups at other study time points. Their study showed no differ-

ences between the 2 groups who got 0.2 mg or 0.5 mg of morphine (24).

Postoperative hemodynamic indicators (diastolic and systolic blood pressure, and heart rate) were sustained within normal ranges in a study conducted by El-Sherif et al. (25) with no significant alterations in patients undergoing laparoscopic bariatric surgery ($P > 0.05$).

In our study, we found that postoperative oxygen saturation was significantly lower at all postoperative study time points in the ITM group, which showed the effect of ITM on respiratory depression and decreased oxygen saturation in patients taking this dose (0.3 mg) intrathecally. Similar results were reported by Cole et al (26) with patients receiving 0.3 mg of ITM for postoperative analgesia after knee arthroplasty. Law et al (27) reported a case of severe hypercarbia of 181 mm Hg in a patient weighing 58 kg who was administered 0.4 mg of ITM following lumbar spine surgery. On the other hand, El-Sherif et al (25) compared a 0.3 mg ITM dose to saline in patients who were morbidly obese having laparoscopic bariatric surgery and discovered that the respiratory rate and postoperative peripheral oxygen saturation did not differ between the groups during the study period, which lasted up to 24 hours ($P > 0.05$). This difference between our study and El-Sherif's study (25) can be attributed to the type of surgery (lumbar surgery versus laparoscopic bariatric surgery), type of patients in the 2 studies (ASA physical status I or II in ours compared to ASA II or III in theirs), or due to the use of routine oxygen nasal cannula (4 L/min) postoperatively in El-Sherif's study (25).

In our study, we found a significant difference in the Ramsay Sedation Scale score between the 2 study groups at 2 hours, 4 hours, and 6 hours postoperatively. However, this significance did not need any intervention. On the other hand, Kara et al (28) reported that sedation was similar between their study groups. The difference between our results and theirs may be that they compared ITM with intravenous patient-controlled analgesia with morphine continued for 48 hours, which might increase sedation the score and mask any variation in sedation between the groups (28). Also, in a study by Fares et al (24), no patient demonstrated any degree of sedation, although they used different doses of ITM in that study. Their study had limitations, according to them, by the small sample size, and all patients taking neuraxial opioids should be examined for correct ventilation (e.g., respiratory rate and depth of respiration), oxygenation (e.g., appropriate pulse oximetry), and degree of consciousness (24). In Sawi and Choy's study on parturients undergoing cesarean delivery (14) , none of the patients developed sedation due to a much smaller dose of ITM (0.1 mg) compared to intrathecal fentanyl. McMorrow et al (29) did not record any significant difference between their groups' sedation scores; their assessment began 6 hours postoperatively.

In our study, the time to the first analgesic request was significantly longer in the ITM group; total postoperative pethidine consumption at postoperative 48 hours was significantly lower in the ITM group than in the ESPB group; in comparison, a nonsignificant difference was observed in intraoperative fentanyl consumption. This could be attributed to the extended analgesic effect of ITM postoperatively that lasted 48 hours. In comparison, the intraoperative fentanyl dose continued for only 2 hours only produced excellent pain relief during the operation.

In concordance with our results, Terajima et al (30), in their study on patients receiving elective cesarean delivery, found a significant difference in the time to the first request for additional analgesia when comparing ITM of 0.2 mg to placebo ($P < 0.001$). Also, Karaman et al., who compared intrathecal morphine with fentanyl or combined, reported that the time to the first postoperative analgesic request was significantly longer in the intrathecal morphine group when compared with the intrathecal fentanyl or combined groups ($P < 0.05$) (31). Similarly, in a trial with live liver donors, Ko et al (32) found that the amount of extra meperidine doses needed during the first 24 hours postsurgery, as well as the total amount of meperidine consumed until 72 hours postsurgery, was much lower in the ITM group (32).

Karaman et al (31) did not find a significant difference in the quality of intraoperative analgesia, which agreed with our finding. Compared to our results, Weigl et al (33), in their study on cesarean delivery, found a significant difference in the additional intraoperative analgesia ($P < 0.01$) when they compared ITM/fentanyl with ITM alone. However, this difference could be explained by using spinal anesthesia for cesarean delivery with a delay in action when using morphine alone (30 to 60 minutes). Whereas in our study, we utilized general anesthesia for lumbar surgery using intraoperative opioids.

Regarding the occurrence and incidence of complications, a significantly lower incidence of complications was found in the ESPB group compared to the

ITM group ($P < 0.001$). The most common complication associated with the use of ITM is urine retention, accounting for approximately 30% of cases. Gonvers et al (34), in a systematic review and meta-analysis of 24 trials, discovered that ITM increased postoperative nausea and vomiting with a risk ratio of 1.4 ($P < 0.0001$). Moreover, the risk increased significantly with larger doses (subgroup difference $P = 0.02$) (34). Tomaszewski et al (35) discovered that patients receiving spinal anesthesia with ITM, combined with a 0.5% hyperbaric solution of bupivacaine, had a higher incidence of urinary catheterization and a longer time to urinary retention recovery.

In the same way, Ruan (36) had an estimated rate of complications of 42% to 80%, which was increasingly more common in elderly patients. Furthermore, he concluded that most of the negative consequences of ITM were dose-dependent and opioid receptor-mediated. Nausea, pruritus, urine retention, vomiting, and constipation were the most common. At the same time, respiratory depression was found to be the least common, which corroborates our findings (36).

Limitation

We did not measure patient preoperative VAS scores to ensure that the 2 groups were matched in pain severity. Also, we did not compare patient satisfaction. Another limitation was the inability to determine the degree of pain relief of ESPB since there was no control group in our study. Pruritus prophylaxis was administered. In procedures involving moderate to severe pain, we advocate using ITM to induce analgesia. Also, we recommend performing randomized trials with a smaller dose of ITM to assess the incidence of complications and pain scale scores.

Conclusion

We conclude that ITM with a dose of 0.3 mg provides more substantial and extended analgesia up to 48 hours postoperatively than an ESPB, as measured by VAS scores at different time points and doses of postoperative analgesic requirements.

References

1. Kurd MF, Kreitz T, Schroeder G, Vaccaro AR. The role of multimodal analgesia in spine surgery. *J Am Acad Orthop Surg* 2017; 25:260-268.
2. Yayik AM, Cesur S, Ozturk F, et al. Postoperative analgesic efficacy of the ultrasound-guided erector spinae plane block in patients undergoing lumbar spinal decompression surgery: A randomized controlled study. *World Neurosurg* 2019; 126:e779-e785.
3. Bhoi D, Ranjitha N, Talawar P, Narasimhan P. A novel out plane technique of midpoint transverse process to pleura block in breast surgery: A case report. *Saudi J Aneasth* 2018; 12:637-639.
4. Forero M, Adhikary SD, Lopez H, Tsui C, Chin KJ. The erector spinae plane block: A novel analgesic technique in thoracic neuropathic pain. *Reg Anesth Pain Med* 2016; 41:621-627.
5. Liang X, Zhou W, Fan Y. Erector spinae plane block for spinal surgery: A systematic review and meta-analysis. *Korean J Pain* 2021; 34:487-500.
6. Pöpping DM, Elia N, Marret E, Wenk M, Tramèr MR. Opioids added to local anesthetics for single-shot intrathecal anesthesia in patients undergoing minor surgery: A meta-analysis of randomized trials. *Pain* 2012; 153:784-793.
7. Meylan N, Elia N, Lysakowski C, Tramer M. Benefit and risk of intrathecal morphine without local anaesthetic in patients undergoing major surgery: Meta-analysis of randomized trials. *Br J Anaesth* 2009; 102:156-167.
8. De Sousa K, Chandran R. Intrathecal morphine for postoperative analgesia: current trends. *World J Anesthesiol* 2014; 3:191-202.
9. Sessler CN, Grap MJ, Ramsay MA. Evaluating and monitoring analgesia and sedation in the intensive care unit. *Crit Care* 2008; 12 Suppl 3(Suppl 3):S2.
10. Faul F, Erdfelder E, Buchner A, Lang A-G. Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. *Behav Res Methods* 2009; 41:1149-1160.
11. Eskin M, Ceylan A, Özhan MÖg, Atik B. Ultrasound-guided erector spinae block versus mid-transverse process to pleura block for postoperative analgesia in lumbar spinal surgery. *Anaesthesist* 2020; 69:742-750.
12. Dhaliwal P, Yavin D, Whittaker T, et al. Intrathecal morphine following lumbar fusion: A randomized, placebo-controlled trial. *Neurosurgery* 2019; 85:189-198.
13. Kroin JS, Ali A, York M, Penn RD. The distribution of medication along the spinal canal after chronic intrathecal administration. *Neurosurgery* 1993; 33:226-230.
14. Sawi W, Choy Y. A comparative study of post operative analgesia, side effects profile and patient satisfaction using intrathecal fentanyl with and without morphine 0.1 mg in caesarean section. *Middle East J Anaesthesiol* 2013; 22:21-26.
15. Kong SK, Onsiong S, Chiu W, Li M. Use of intrathecal morphine for postoperative pain relief after elective laparoscopic colorectal surgery. *Anaesthesia* 2002; 57:1168-1173.
16. Ziegeler S, Fritsch E, Bauer C, et al. Therapeutic effect of intrathecal morphine after posterior lumbar interbody fusion surgery: A prospective, double-blind, randomized study. *Spine (Phila Pa 1976)* 2008; 33:2379-2386.
17. Raw D, Beattie J, Hunter J. Anaesthesia for spinal surgery in adults. *Br J Anaesth* 2003; 91:886-904.
18. Urban MK, Jules-Elysee K, Urquhart B, Cammisa FP, Boachie-Adjei O. Reduction in postoperative pain after spinal fusion with instrumentation using intrathecal morphine. *Spine (Phila Pa 1976)* 2002; 27:535-537.
19. Hindle A. Intrathecal opioids in the management of acute postoperative

pain. Continuing Education in Anaesthesia, *Critical Care and Pain* 2008; 8:81-85.

20. Cosgrave D, Shanahan E, Conlon N, Joshi M. Intrathecal opioids. *ATOTW*; 2017:1-6.
21. Raphael JH, Duarte RV, Southall JL, Nightingale P, Kitas GD. Randomised, double-blind controlled trial by dose reduction of implanted intrathecal morphine delivery in chronic non-cancer pain. *BMJ Open* 2013; 3:e003061.
22. Cousins M, Mather L, Glynn C, Wilson P, Graham J. Selective spinal analgesia. *Lancet* 1979;1:1141-1142.
23. Chin KJ, El-Boghdadly K. Mechanisms of action of the erector spinae plane (ESP) block: A narrative review. *Can J Anaesth* 2021; 68:387-408.
24. Fares KM, Mohamed SA, Abdel-Ghaffar HS. High dose intrathecal morphine for major abdominal cancer surgery: A prospective double-blind, dose-finding clinical study. *Pain Physician* 2014; 17:255-264.
25. El Sherif FA, Othman AH, Abd El-Rahman AM, Taha O. Effect of adding intrathecal morphine to a multimodal analgesic regimen for postoperative pain management after laparoscopic bariatric surgery: A prospective, double-blind, randomized controlled trial. *Br J Pain*. 2016; 10:209-216.
26. Cole P, Craske D, Wheatley R. Efficacy and respiratory effects of low-dose spinal morphine for postoperative analgesia following knee arthroplasty. *Br J Anaesth* 2000; 85:233-237.
27. Law CJ, Visser EJ. Unconsciousness and severe respiratory depression following intrathecal morphine analgesia for lumbar spinal surgery. *Acute Pain* 2007; 9:163-167.
28. Kara I, Apiliogullari S, Oc B, et al. The effects of intrathecal morphine on patient-controlled analgesia, morphine consumption, postoperative pain and satisfaction scores in patients undergoing gynaecological oncological surgery. *J Int Med Res* 2012; 40:666-672.
29. McMorrow R, Ni Mhuircheartaigh R, Ahmed K, et al. Comparison of transversus abdominis plane block vs spinal morphine for pain relief after caesarean section. *Br J Anaesth* 2011; 106:706-712.
30. Terajima K, Onodera H, Kobayashi M, Yamanaka H, Ohno T, Konuma S, et al. Efficacy of intrathecal morphine for analgesia following elective cesarean section: Comparison with previous delivery. *J Nippon Med Sch* 2003; 70:327-333.
31. Karaman S, Günüsen I, Uyar M, Biricik E, Fırat V. The effects of morphine and fentanyl alone or in combination added to intrathecal bupivacaine in spinal anesthesia for cesarean section. *Agri* 2011; 23:57-63.
32. Ko JS, Choi SJ, Gwak MS, et al. Intrathecal morphine combined with intravenous patient-controlled analgesia is an effective and safe method for immediate postoperative pain control in live liver donors. *Liver Transpl* 2009; 15:381-389.
33. Weigl W, Bieryło A, Wielgus M, Krzemień-Wiczyńska Ś, Kołacz M, Dąbrowski MJ. Perioperative analgesia after intrathecal fentanyl and morphine or morphine alone for cesarean section: A randomized controlled study. *Medicine (Baltimore)* 2017; 96:e8892.
34. Gonvers E, El-Boghdadly K, Grape S, Albrecht E. Efficacy and safety of intrathecal morphine for analgesia after lower joint arthroplasty: A systematic review and meta-analysis with meta-regression and trial sequential analysis. *Anaesthesia* 2021; 76:1648-1658.
35. Tomaszewski D, Bałkota M, Truszczyński A, Machowicz A. Intrathecal morphine increases the incidence of urinary retention in orthopaedic patients under spinal anaesthesia. *Anaesthesiol Intensive Ther* 2014; 46:29-33.
36. Ruan X. Drug-related side effects of long-term intrathecal morphine therapy. *Pain Physician* 2007; 10:357-366.